REMARKS

Applicants thank the Examiner for the thorough examination given the present application.

Status of the Claims and Specification

The present specification has been amended to correct an apparent clerical error. Support for this amendment can be found from the context of paragraph [0078] that recites the phrase "**carbonate** ether content of the dialkyl carbonate produced" (page 46, lines 20-21; emphasis added).

Claims 1-8 are pending in the above-identified application. Claim 1 has been amended. Support for the recitations in claim 1 can be found in the present specification, *inter alia*, at paragraph [0037]. Thus, no new matter has been added. Based upon the above considerations, entry of the present amendment is respectfully requested.

In view of the following remarks, Applicants respectfully request that the Examiner withdraw all rejections and allow the currently pending claims.

Issues under 35 U.S.C. § 112, first paragraph

The Examiner has rejected claims 1-5 under 35 U.S.C. § 112, first paragraph, because the specification, while being enabling for diol compounds represented by formula (D), does not reasonably provide enablement for all diol compounds. The Examiner notes that the incorporation of the limitation of diol compounds of formula (D) would overcome the outstanding rejection. Applicants respectfully traverse in view of the amended claim.

Claim 1 has been amended in accordance with the Examiner's suggestion. Specifically, Applicants have amended claim 1 to state that the product diol is represented by the formula: HO-R^1-OH wherein R^1 is as defined for the formula (1). As such, Applicants respectfully submit that this amendment overcomes the outstanding rejection and that the rejection should be removed.

Issues under 35 U.S.C. § 103(a)

The Examiner has rejected claims 1-5 under 35 U.S.C. § 103(a) as being unpatentable over Tojo et al. '638 (US 6,346,638) or Tojo et al. '689 (US 6,479,689).

Applicants respectfully traverse. Reconsideration and withdrawal of the outstanding rejection are respectfully requested based on the following considerations.

Legal Standard for Determining Prima Facie Obviousness

MPEP 2141 sets forth the guidelines in determining obviousness. First, the Examiner has to take into account the factual inquiries set forth in *Graham v. John Deere*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966), which has provided the controlling framework for an obviousness analysis. The four *Graham* factors are:

(a) determining the scope and content of the prior art;

(b) ascertaining the differences between the prior art and the claims in issue;

(c) resolving the level of ordinary skill in the pertinent art; and

(d) evaluating any evidence of secondary considerations.

Graham v. John Deere, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966).

Second, the Examiner has to provide some rationale for determining obviousness. MPEP 2143 sets forth some rationales that were established in the recent decision of *KSR International Co. v Teleflex Inc.*, 82 USPQ2d 1385 (U.S. 2007). Exemplary rationales that may support a conclusion of obviousness include:

(a) combining prior art elements according to known methods to yield predictable results;

(b) simple substitution of one known element for another to obtain predictable results;

(c) use of known technique to improve similar devices (methods, or products) in the same way;

(d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;

(e) "obvious to try" – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success

(f) known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art;

(g) some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

As the MPEP directs, all claim limitations must be considered in view of the cited prior art in order to establish a *prima facie* case of obviousness. *See* MPEP 2143.03.

State of the Art and Features and Advantages of the Present Invention

Before specifically discussing the obviousness rejection of the claims, the following background information should be considered in order to shed a proper light on the development of the present invention and the advantageous features thereof. As discussed in the present specification at paragraphs [0004]-[0007], the conventional methods for producing a dialkyl carbonate and a diol by reacting a cyclic carbonate with an aliphatic monohydric alcohol can be classified into the following four methods:

(1) A completely batchwise method;

(2) A batchwise method using a reaction vessel provided at an upper portion thereof with a distillation column;

(3) A liquid flow method using a tubular reactor; and

(4) A reactive distillation method.

However, these four methods have their respective problems (paragraphs [0009]-[0010]). In the method for producing a dialkyl carbonate and a diol by reacting a cyclic carbonate with an aliphatic monohydric alcohol, the occurrence of a specific carbonate ether described in the present invention was **not** previously known. The **present inventors** have **for the first time** found that a dialkyl carbonate obtained by the above-mentioned method contains a specific carbonate ether and that when a dialkyl carbonate contains the carbonate ether in an amount exceeding a specific level, the reaction using such a dialkyl carbonate as a raw material poses

various problems. For example, when a transesterification aromatic carbonate is produced from such a **conventional** dialkyl carbonate and phenol, the produced aromatic carbonate will contain **impurities**.

As can be understood from the above, **no** method has heretofore been proposed for producing a dialkyl carbonate and a diol from a cyclic carbonate and an aliphatic monohydric alcohol, wherein the produced dialkyl carbonate contains the specific carbonate ether **only** in a content which is **reduced to a specific low range**.

The discovery of the problem is relevant to patentability. Applicants respectfully submit that the discovery of the source of the problem would have been unobvious to one of ordinary skill in the art. It is insufficient to argue that "the source of the problem would have been discovered." *In re Peehs*, 612 F.2d 1287, 204 USPQ 835, 837 (CCPA 1980). In the present situation, the problem had not been identified. If the problem was not recognized (which it had not been), a solution to the unrecognized problem could not have been *prima facie* obvious. *In re Sponnoble*, 405 F.2d 578, 160 USPQ 237 (CCPA 1969) and *Ex parte Campbell*, 211 USPQ 575 (Bd. App. 1981). According to MPEP 2141.02(III), a patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the "subject matter as a whole" which should always be considered in determining the obviousness of an invention under 35 U.S.C. § 103.

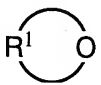
In this situation, for solving the above-mentioned problems, the present inventors have **unexpectedly** found that, in a method for producing a dialkyl carbonate and a diol comprising effecting a transesterification reaction between a cyclic carbonate and an aliphatic monohydric alcohol in the presence of a transesterification catalyst, thereby producing a product dialkyl carbonate and a product diol, when the cyclic carbonate as a raw material contains a specific cyclic ether, a specific carbonate ether is by-produced and enters the dialkyl carbonate produced. They have **also found** that, by reducing the cyclic ether content of the cyclic carbonate as a raw material, the carbonate ether content of the dialkyl carbonate produced can be reduced. Specifically, the present inventors **have found** that the above-mentioned problems can be solved by a method for producing a dialkyl carbonate and a diol, comprising: (a) effecting a transesterification reaction between a **cyclic carbonate** and an aliphatic monohydric alcohol in

the presence of a transesterification catalyst, thereby obtaining a reaction mixture containing a product **dialkyl carbonate** and a product diol, (b) withdrawing a dialkyl carbonate-containing liquid from the reaction mixture, followed by separation of the **dialkyl carbonate** from the dialkyl carbonate-containing liquid, and (c) withdrawing a diol-containing liquid from the reaction mixture, followed by separation of the diol from the diol-containing liquid, wherein the **cyclic carbonate** employed contains a specific **cyclic ether (of formula (1))** in an amount of from **0.1 to 3,000 ppm by weight,** and the product **dialkyl carbonate** contains a specific **carbonate ether (of formula (2))** in an amount of **not more than 10,000 ppm by weight**.

An object of the present invention is to provide a method for producing a dialkyl carbonate containing a specific carbonate ether (which is a conventionally **unknown** impurity) **only** in an amount which is **reduced to a specific low range,** wherein the dialkyl carbonate can be used to produce a transesterification aromatic carbonate which can be very advantageously used to produce a ***colorless, high molecular weight*** aromatic polycarbonate.

As amended, **claim 1** recites:

> A method for producing a dialkyl carbonate and a diol, comprising:
>
> (a) effecting a transesterification reaction between a ***cyclic carbonate*** and an aliphatic monohydric alcohol in the presence of a transesterification catalyst, thereby obtaining a reaction mixture containing a *product* ***dialkyl carbonate*** and a product diol represented by the formula: HO-R^1-OH wherein R^1 is as defined below for the formula (1),
>
> (b) withdrawing a dialkyl carbonate-containing liquid from said reaction mixture, followed by separation of the **dialkyl carbonate** from the dialkyl carbonate-containing liquid, and
>
> (c) withdrawing a diol-containing liquid from said reaction mixture, followed by separation of the diol from the diol-containing liquid,
>
> said steps (b) and (c) being performed in either order or simultaneously,
>
> wherein:
>
> said ***cyclic carbonate*** contains a ***cyclic ether*** represented by the ***formula (1)*** below in an amount of ***from 0.1 to 3,000 ppm by weight,*** and
>
> said *product* ***dialkyl carbonate*** contains a ***carbonate ether*** represented by the ***formula (2)*** below in an amount of ***not more than 10,000 ppm by weight,***



(1)

wherein R^1 represents a divalent group represented by the formula: $-(CH_2)_m-$ wherein m is an integer of from 2 to 6, and at least one hydrogen atom of R^1 is optionally replaced by at least one substituent group selected from the group consisting of a C_{1-10} alkyl group and a C_{6-10} aryl group, and

$$R^2OR^1OCOOR^2 \qquad (2)$$

wherein R^1 is as defined above for formula (1), R^2 represents a C_{1-12} monovalent aliphatic group, and at least one hydrogen atom of R^2 is optionally replaced by at least one substituent group selected from the group consisting of a C_{1-10} alkyl group and a C_{6-10} aryl group.

With respect to the reason for the *lower limit* value (0.1 ppm) of the cyclic ether content range (0.1 to 3,000 ppm) recited in claim 1, attention is drawn to the following description of the present specification:

> [0043] In the cyclic carbonate used in the present invention, the content of a cyclic ether represented by the formula (1) above is preferably 3,000 ppm or less. **The lower** the cyclic ether content of the cyclic carbonate, **the lower** the carbonate ether content of the dialkyl carbonate produced. **However,** for producing a cyclic carbonate **having extremely low cyclic ether content,** the cyclic carbonate must be produced by a method employing **a special purification method. Therefore,** in the present invention, the cyclic ether content of the cyclic carbonate is in the range of from **0.1** to 3,000 ppm, preferably from 1 to 3,000 ppm, more preferably from 3 to 1,500 ppm, most preferably from 10 to 1,000 ppm (emphasis added).

Thus, as seen from the above-quoted description of the present specification, the cyclic ether content of the cyclic carbonate is preferred to be as low as possible.

In the method of claim 1 of the present application, the **cyclic ether content** of the cyclic carbonate used is in the range of **from 0.1 to 3,000 ppm**.

On the other hand, with respect to the **cyclic ether content** of a cyclic carbonate **previously** used, the present specification states as follows:

> [0044] With respect to the ***cyclic ether content*** of a cyclic carbonate obtained in **the prior art**, attention is drawn to the following. When ethylene carbonate (which is a cyclic carbonate) is produced from ethylene oxide (which is a cyclic ether), it is generally known that the conversion of ethylene oxide is 99.0 %, and the selectivity for ethylene carbonate is 99.2 % (see, e.g., U.S. Patent Nos. 4,166,773, 4,786,741 and 4,314,945). That is, in the **prior art**, the ethylene

carbonate (cyclic carbonate) produced inevitably contains **about 5,000 ppm of ethylene oxide (cyclic ether)** which remains unreacted. Therefore, *in the* ***prior art****, it is* ***impossible*** to obtain the cyclic carbonate used in the method of the present invention, the cyclic carbonate having the cyclic ether content reduced to the above-mentioned specific range (i.e., 0.1 to 3,000 ppm) (emphasis added).

Thus, as seen from the above-quoted description of the ***present specification***, in the **prior art**, the ethylene carbonate (cyclic carbonate) produced inevitably contains **about 5,000 ppm of ethylene oxide (cyclic ether)** which remains unreacted.

Therefore, the **cyclic ether content (from 0.1 to 3,000 ppm)** of the cyclic carbonate used in the method of the present invention is ***far lower than*** the **cyclic ether content (about 5,000 ppm)** of the cyclic carbonate used in ***the prior art***.

Further, the method of the present invention exhibits **excellent effects**, i.e., the effects that, in the dialkyl carbonate produced by the method of the present invention, the content of a carbonate ether (i.e., the carbonate ether of formula (2), which is a conventionally **unknown** impurity) is reduced to a specific low range, so that, when the dialkyl carbonate obtained is used to produce a transesterification aromatic carbonate, the transesterification aromatic carbonate produced can be very advantageously used to produce a ***colorless, high molecular weight*** aromatic polycarbonate, as compared to the case of the use of a dialkyl carbonate produced by any of the previous methods.

The **use** of a cyclic carbonate containing the cyclic ether of formula (1) in an amount of from 0.1 to 3,000 ppm by weight is **critical for** achieving the above-mentioned **excellent effects** of the method of the present invention. The **criticality** is **fully substantiated** by **Examples 1 to 3 and Comparative Example 1** of the present specification.

For easier reference and understanding, the **most important data** (namely, *cyclic ether content* of cyclic carbonate used; *carbonate ether content* of dialkyl carbonate obtained; and *number average molecular weight and color* of ultimate aromatic polycarbonate) of Examples 1 to 3 and Comparative Example 1 of the present specification are collected and summarized in Table A below.

Table A

	Cyclic carbonate used	Dialkyl carbonate obtained	Ultimate aromatic polycarbonate	
	Content of **cyclic ether** (formula (1))	Content of **carbonate ether** (formula (2))	Number average molecular weight	Color
	ethylene oxide	$CH_3OCH_2CH_2OCOOCH_3$		
Example 1 (present invention)	400 ppm	1,150 ppm	10,500	colorless and transparent
Example 2 (present invention)	1,200 ppm	3,400 ppm	10,200	colorless
Example 3 (present invention)	2,000 ppm	5,600 ppm	9,100	colorless
Comparative *Example 1*	***5,000 ppm*** *(higher than the range recited in claim 1)*	***15,300 ppm*** *(higher than the range recited in claim 1)*	***6,300*** *(poor)*	***yellow*** *(poor)*

As indicated in Table A above, in **Examples 1 to 3** of the present application, the **cyclic ether contents** of cyclic carbonate used are in the range of 400 to 2,000 ppm, which is **within** the range **(from 0.1 to 3,000 ppm)** recited in claim 1. As a result, the **carbonate ether content** of the dialkyl carbonate obtained in Examples 1 to 3 of the present application are in the range of 1,150 to 5,600 ppm, which is **within** the range **(not more than 10,000 ppm)** recited in claim 1.

In each of Examples 1 to 3 of the present application, such dialkyl carbonate obtained (having a carbonate ether content of **not more than 10,000 ppm**) and phenol are subjected to a transesterification reaction, thereby obtaining an aromatic carbonate (diphenyl carbonate).

Then, in each of Examples 1-3, the obtained diphenyl carbonate and bisphenol A are subjected to a polycondensation reaction to obtain an **aromatic polycarbonate**. As indicated in Table A above, the thus obtained aromatic polycarbonates of Examples 1-3 are ***colorless*** and have high ***number average molecular weights*** in the range of from **9,100 to 10,500.**

By contrast, as also indicated in Table A above, the **cyclic ether content** of cyclic carbonate used in Comparative Example 1 is 5,000 ppm, which is **higher than** the range (**from 0.1 to 3,000 ppm**) recited in claim 1. As a result, the **carbonate ether content** of dialkyl carbonate obtained in Comparative Example 1 is 15,300 ppm, which is **higher than** the range (**not more than 10,000 ppm**) recited in claim 1. The obtained dialkyl carbonate (having a carbonate ether content of 15,300 ppm) and phenol are subjected to a transesterification reaction, thereby obtaining an aromatic carbonate (diphenyl carbonate). Then, the obtained diphenyl carbonate and bisphenol A are subjected to a polycondensation reaction, thereby obtaining an **aromatic polycarbonate**. As indicated in Table A above, the thus obtained aromatic polycarbonate is **yellow** (i.e., exhibiting discoloration) and has a **number average molecular weight** as low as **6,300.**

Thus, the results of Examples 1 to 3 and Comparative Example 1 of the present specification clearly show that a **colorless, high molecular weight** aromatic polycarbonate can be obtained **only when** the **cyclic ether content** of cyclic carbonate used is within the range (**from 0.1 to 3,000 ppm**) recited in claim 1.

From the above, it is apparent that **the use** of a cyclic carbonate containing the cyclic ether of formula (1) in an amount of from 0.1 to 3,000 ppm by weight is **critical for** achieving the above-mentioned **excellent effects** of the method of the present invention, i.e., the effects that, in the dialkyl carbonate produced by the method of the present invention, the content of a carbonate ether (i.e., the carbonate ether of formula (2), which is a conventionally **unknown** impurity) is reduced to a specific low range so that, when the dialkyl carbonate obtained is used to produce a transesterification aromatic carbonate, the transesterification aromatic carbonate produced can be very advantageously used to produce a ***colorless, high molecular weight*** aromatic polycarbonate, as compared to the case of the use of a dialkyl carbonate produced by any of the previous methods.

Such excellent effects of the method of the present invention are **not** taught or suggested by and are quite **unexpected** from the cited references since, as described above, a cyclic carbonate produced by a conventional method inevitably contains the cyclic ether of formula (1) in an amount as large as about 5,000 ppm (see above as well as paragraph [0044] of the present specification).

Distinctions over the Cited References

In the outstanding Office Action, the Examiner states:

> The difference between the instant claims and Tojo et al. '638 or '689 respectively is that the instant processes comprising withdrawing a dialkyl carbonate (i.e., step (b)) and diol, (i.e., step (c)) in order or simultaneously, while Tojo et al. '638 or '689 respectively are operated simultaneously. Tojo et al. '638 or '689 processes inherently overlap with the instant invention respectively.
> ...
>
> One having ordinary skill in the art would find the claims 1-5 prima facie obvious because one would be motivated to employ the processes of Tojo et al. '638 or '689, wherein dialkyl carbonate and a diol are prepared by reacting [a] cyclic carbonate with aliphatic monohydric alcohol in the presence of a catalyst, and a dialkyl carbonate (i.e., step (b)) and diol, (i.e., step (c)) are withdrawn in order or simultaneously. Dependent claims 2-5 are also rejected along with claim 1 under 35 U.S.C. 103(a) (page 9 of the outstanding Office Action).

Applicants respectfully traverse and submit that Tojo et al. '638 and/or Tojo et al. '689 (collectively referred to as "Tojo") do not disclose each and every element of independent claim 1.

As described above with reference to paragraph [0044] of the present specification, using **previous** methods, the ethylene carbonate (cyclic carbonate) produced inevitably contains **about 5,000 ppm of ethylene oxide (cyclic ether)**, which remains unreacted.

Tojo does **not** disclose that the **cyclic ether content** of cyclic carbonate used should be reduced to a level in the range of from 0.1 to 3,000 ppm as recited in claim 1 of the present application.

Further, Tojo does **not** disclose that the **carbonate ether content** of dialkyl carbonate produced should be reduced to a level in the range of 10,000 ppm or less as recited in claim 1 of the present application.

Thus, Tojo does **not** disclose **the fact** that a cyclic carbonate contains a cyclic ether of formula (1) and do **not** disclose **the fact** that a dialkyl carbonate contains a carbonate ether of formula (2).

Further, as described above, the **use** of a cyclic carbonate containing the cyclic ether of formula (1) in an amount of from 0.1 to 3,000 ppm by weight is **critical for** achieving the above-mentioned **excellent effects** of the method of the present invention, i.e., the effects that, in the dialkyl carbonate produced by the method of the present invention, the content of a carbonate ether (i.e., the carbonate ether of formula (2), which is a conventionally **unknown** impurity) is reduced to a specific low range so that, when the dialkyl carbonate obtained is used to produce a transesterification aromatic carbonate, the transesterification aromatic carbonate produced can be very advantageously used to produce a ***colorless, high molecular weight*** aromatic polycarbonate, as compared to the case of the use of a dialkyl carbonate produced by any of the previous methods.

Such excellent effects of the method of the present invention are **not** disclosed by and are quite **unexpected** from Tojo.

Relevant to this § 103(a) rejection, *Graham v. John Deere*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966) has provided the controlling framework for an obviousness analysis, wherein a proper analysis under § 103(a) requires consideration of the four *Graham* factors. One such factor includes the evaluation of any evidence of secondary considerations (e.g., commercial success; unexpected results). 383 U.S. at 17, 148 USPQ at 467. In this regard, Applicants respectfully submit that the present invention has achieved unexpected results, whereby such results rebut any asserted *prima facie* case of obviousness. *See In re Corkill*, 711 F.2d 1496, 226 USPQ 1005 (Fed. Cir. 1985). Also, the comparative showing need not compare the claimed invention with all of the cited prior art, but only with the closest prior art. *See* MPEP 716.02(b) and 716.02(e).

According to MPEP 2145, rebuttal evidence and arguments can be presented in the specification, *In re Soni*, 54 F.3d 746, 750, 34 USPQ2d 1684, 1687 (Fed. Cir. 1995). Office personnel should consider all rebuttal arguments and evidence presented by Applicants. See, e.g., *Soni*, 54 F.3d at 750, 34 USPQ2d at 1687 (error not to consider evidence presented in the specification). Rebuttal evidence may also include evidence that the claimed invention yields unexpectedly improved properties or properties not present in the prior art. Rebuttal evidence may consist of a showing that the claimed compound possesses unexpected properties. *In re Dillon*, 919 F.2d 688, 692-93, 16 USPQ2d 1897, 1901 (Fed. Cir. 1990).

Thus, due to the unexpected results as achieved by the present invention, the rejection has been overcome. Reconsideration and withdrawal of this rejection are respectfully requested.

Moreover, to establish a *prima facie* case of obviousness of a claimed invention, all of the claim limitations must be disclosed by the cited references. As discussed above, Tojo fails to disclose all of the claim limitations of independent claim 1, and those claims dependent thereon. Accordingly, Tojo does not render the present invention obvious. Furthermore, the cited references or the knowledge in the art provide no reason or rationale that would allow one of ordinary skill in the art to arrive at the present invention as claimed. Therefore, a *prima facie* case of obviousness has not been established, and withdrawal of the outstanding rejection is respectfully requested. Any contentions of the USPTO to the contrary must be reconsidered at present.

Double Patenting

The Examiner has rejected claims 1-5 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 1 of Tojo et al. '638 or claims 1 and 8 of Tojo et al. '689.

Applicants respectfully traverse. Reconsideration and withdrawal of the outstanding rejection are respectfully requested based on the following considerations.

As the double patenting rejection recite the same patents as used for the rejection under 35 U.S.C. § 103(a), Applicants respectfully submit that this rejection has been overcome for the reasons given above. As such, Applicants respectfully request that the rejection be removed.

CONCLUSION

A full and complete response has been made to all issues as cited in the Office Action. Applicants have taken substantial steps in efforts to advance prosecution of the present application. Thus, Applicants respectfully request that a timely Notice of Allowance issue for the present case clearly indicating that each of claims 1-5 are allowed and patentable under the provisions of title 35 of the United States Code.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Chad M. Rink, Reg. No. 58,258 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

Dated: MAY 22 2009

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